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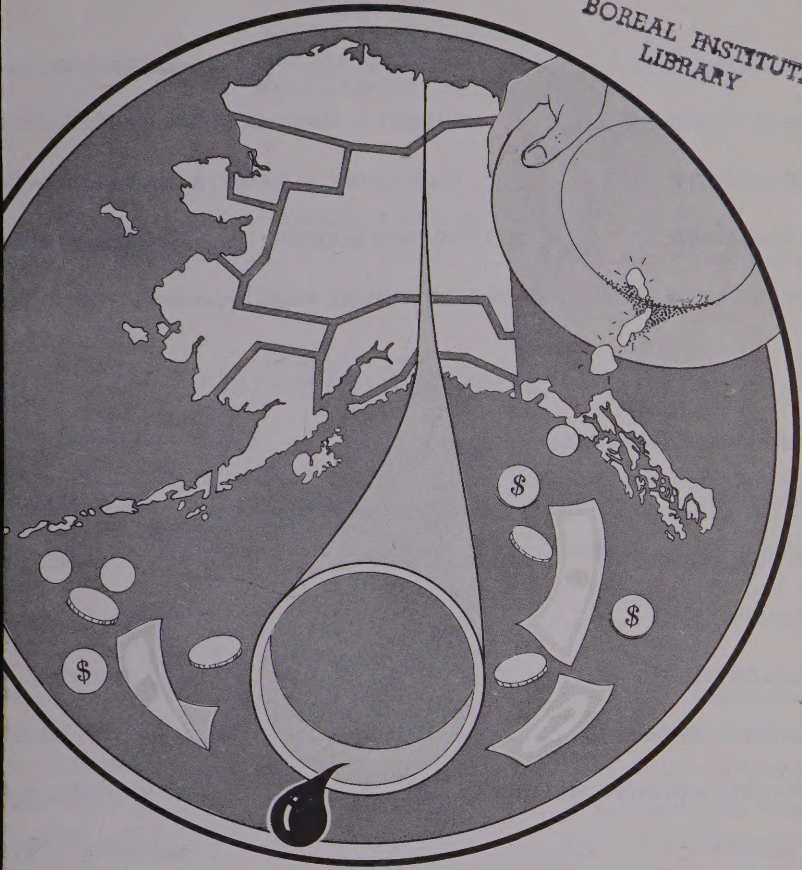

"Alaska's Mineral and Energy Resources, Economics and Land Status"

ALASKA GEOLOGICAL SOCIETY SYMPOSIUM

ANCHORAGE, ALASKA • APRIL 23, 24, 25 — 1979

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SYMPOSIUM SCHEDULE

Captain Cook Hotel
Anchorage, Alaska
April 23-24-25, 1979

SUNDAY, APRIL 22

3:00–7:30 p.m.	Registration

MONDAY, APRIL 23

7:00 a.m.	Registration
8:00 a.m.–11:40 a.m.	Technical Session
11:40 a.m.–1:30 p.m.	Luncheon with Guest Speaker
1:30 p.m.–5:20 p.m.	Technical Session
5:30 p.m.	Icebreaker Cocktail Party

TUESDAY, APRIL 24

7:00 a.m.	Registration
7:00 a.m.–8:00 a.m.	Speaker's Breakfast
8:00 a.m.–12:00 noon	Technical Session
12:00 noon–1:30 p.m.	Luncheon Break
1:30 p.m.–5:20 p.m.	Technical Session
6:30 p.m.	Cocktails and Alaskan Seafood Buffet

WEDNESDAY, APRIL 25

8:00 a.m.	Registration
8:00 a.m.–11:50 a.m.	Technical Session
11:50 a.m.–1:30 p.m.	Luncheon with Guest Speaker
1:30 p.m.–2:50 p.m.	Technical Session

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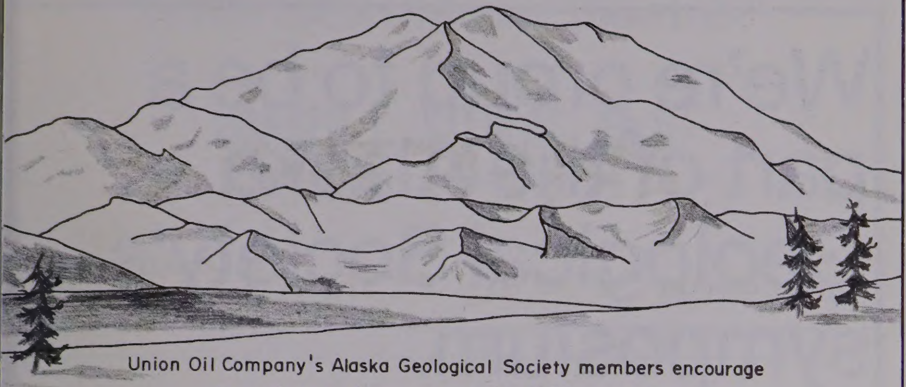

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Monday Morning, April 23, 1979
8:00–11:40 a.m.

CAPTAIN COOK HOTEL

8:00–8:30 **WELCOMING REMARKS**
ARLEN EHM, President, Alaska Geological Society,
PETER T. HANLEY, Symposium General Chairman

I. PETROLEUM RESOURCES

8:30–9:10 ALASKA'S ENERGY RESOURCES

GENE P. RUTLEDGE, Technical Director, Resource Development Council for Alaska, Inc. (formerly OMAR)

In August 1976, a significant effort was made to identify the energy resources of Alaska, operations necessary for the development of such resources, and the economic, social, environmental, governmental, conservation, and technological issues associated with their development. This effort was funded by the U. S. Department of Energy and administered by the Alaska Energy Office in the Office of the Governor.

The results of this effort are documented in a two-volume report that was released in early 1978. Conclusions and recommendations in the report include:

– The immediate expansion of surface and subsurface exploration activities. Without adequate knowledge of the magnitude, quality, and location of the resources, critical energy-related and land-related questions cannot be properly addressed by government and private decision makers.

– Immediate attention must be given to technologies for large-scale energy operations that could either extend the recovery life of a specific resource site or would enable development in areas that are otherwise marginal or uneconomical.

– An inventory of alternate energy sources (small hydro, wind, geothermal, solar, and peat) for rural Alaska communities should be conducted, and technologies (waste heat recovery systems, fluidized bed units, heat pumps and fuel cells) to match the available resources should be evaluated.

In summary, Alaska may contain about one-third of the nation's energy resources, but, as the report concludes, because of land tenure and other issues, "a resource is one thing, and the development of that resource is quite another."

9:10–9:50 STATE OF ALASKA OIL AND GAS LEASE BONUS BIDS: A STATISTICAL STUDY

JOHN LOHRENZ, U. S. Geological Survey, Denver; ELMER L. DOUGHERTY, University of Southern California, Los Angeles; PATRICK L. DOBEY, Department of Natural Resources, State of Alaska, Anchorage

State of Alaska oil and gas lease sales have included the North Slope sale on September 10, 1969, in which the highest bonus bids offered averaged over $2,000 per acre, and more than twenty other sales from 1959 through 1974 for which highest bonus bids offered averaged about $30 per acre. We studied the statistical properties of these bids, examining in particular for differences between the North Slope bids and the very much lower bids in the other lease sales. Further, we sought to compare these Alaska bids with the behavior of Federal offshore oil and gas lease bonus bids.

Low, noise bids, i.e., bids so low that they do not appear to be part of the "normal" population of competing bids, occurred preponderantly only in the North Slope sale and then were mostly submitted by one bidder.

Similar to Federal offshore oil and gas lease bonus bids, the bid distributions appeared to be lognormal or, more concisely stated, the hypothesis that the bid distributions were not lognormal could not be rejected. Generally, the pooled standard deviation of the bids, a measure of the disagreement between bids, was higher for these Alaska bids than for Federal offshore bids. Only the cheaper leases as defined by the bidding exhibited a similar amount of disagreement as Federal offshore bids.

Overall, the aggressiveness, compared to competing bids, of a bidder's bids was greater for the larger companies. Joint bids were more aggressive than solo bids. However, in the North Slope sale, surprisingly, the smaller companies were highest bidders with a higher average bonus per acre than the larger companies. No unreasonable departure was found between what aggressive and conservative State of Alaska bidders got with their bidding and what has been predicted for aggressive and conservative, biased bidders.

Perhaps the most interesting finding pertains to the fraction of money left on the table by the highest bidder. In the North Slope sale, we found evidence of "flinching", such as found for Federal offshore oil and gas lease bids. "Flinching" is a tendency of bidders to restrain their bids as the magnitude of the bid becomes large. On the other hand, in the other, cheaper Alaska sales, a disparity opposite of "flinching" was found that can be called "plunging", i.e., a tendency of bidders to bid with less restraint if the bid is smaller.

9:50–10:20 COFFEE BREAK

10:20–11:00 OIL AND GAS RESOURCE ECONOMICS OF THE GULF OF ALASKA

WILLIAM W. WADE, Senior Economist, Dames & Moore, San Francisco, and PETER T, HANLEY, Project Geologist, Dames & Moore, Anchorage

To assess the environmental and socioeconomic impacts of OCS petroleum development in the Northern Gulf of Alaska (OCS Sale No. 55) and Western Gulf of Alaska (OCS Sale No. 46), a set of petroleum development scenarios, based upon various resource levels defined by the USGS, were formulated that represent a reasonable range of technological, economic, and geographic options of hypothetical petroleum development. Our study is part of the Alaska OCS Socioeconomic Studies Program sponsored by the Bureau of Land Management Alaska OCS Office.

The central component of the study was an economic analysis of petroleum development. This analysis defined the minimum field sizes required to justify development under several oil and gas production technologies, established the minimum required price to justify development given field size and selected technology, and identified the key economic and environmental sensitivities that may influence petroleum development.

The development of a discovered field in the harsh environment of the Gulf of Alaska requires a major committment of capital investment and takes 5 or 6 years of construction and drilling after the field is delineated before any return on that investment can be recovered. In the typical 300 to 600 feet of water in the Gulf of Alaska, the cost of conventional fully-equipped large steel platform, sharing a pipeline and a shore terminal to process crude oil for shipment to market, may cost one-half to three-quarters of a billion dollars, not including bonus payments and exploration costs. An investment of this size nearly equals the entire 1977 profits of all but the largest oil companies.

Before committing that kind of money, an oil company must have a reasonably clear idea that the discovered oil field is of sufficient size and has reservoir characteristics to allow a cash flow that will earn the company a minimum rate of return on investment.

Our analysis compared four different production systems, which may be suitable in the Gulf of Alaska, to ascertain which system was the most economic. These systems were:

1. Floating, small (i.e., less costly) production system with no storage and off-shore loading;
2. Steel platform system with no storage and off-shore loading;
3. Concrete or steel platform with storage and off-shore loading;
4. Conventional steel platform with pipeline to shore terminal.

Assuming that the pipeline to shore and the shore terminal can be shared, the analysis shows that the steel platform system generates a higher return on investment than the other systems, all other factors being equal.

If sufficient oil to justify development were found on the Yakatat shelf by several operators, economics would dictate that they share pipelines where possible and share the cost of building a new shore crude shipping terminal. If only one or two fields large enough to justify development were found, economics would dictate a platform with storage capacity and off-shore loading directly to tankers.

The minimum field size to justify development is extremely sensitive to the price of oil, the required return on investment, water depth (which affects platform investment cost), and initial productivity of the wells. The analysis assumed initial productivity per well to be 2,500 B/D with 40 producing wells per platform as the base case. Peak production rate per platform, thus, was 100,000 B/D. The base oil price was assumed to be $12.00.

Two critical conclusions of the analysis are:

1. The minimum field size that will earn a 15% rate of return in water about 300 feet deep is 215 million barrels of recoverable reserves.
2. With initial productivity no higher than 2,500 B/D, no production system limited to 40 wells per platform can recover the oil fast enough in 600 feet of water to earn a 15% rate of return. With 7,500 B/D initial production rate, 320 million barrels of recoverable reserves is the minimum field size that will earn 15% rate of return.

The chances of finding a 200-300 million barrel field sufficient to justify development are very small. The offshore success rate, according to AAPG data, has declined from 19.6 percent for the decade 1956-1965 to 10.2 percent for the decade ending 1975. In 1976 only 5.4 percent of 280 offshore wildcats hit oil or gas.

Of 13,413 on-and-off shore fields discovered in the U. S. between 1956 and 1975, AAPG data show that only 92, or fewer than 1 percent, were larger than 50 million barrels. Thus, the conditional probability of finding oil in a pool greater than 50 million barrels is less than once chance in 1,500-2,000. If this long-shot field is found in water 600 feet in depth, it must also be extremely productive. While there is some correlation between field size and productivity, there is no certainty that a giant field will have a high enough initial production rate to justify development under the difficult conditions of deep water in the Gulf of Alaska.

11:00–11:40 PETROLEUM EXPLORATION OF NPR/A

ARLEN EHM, Geological Consultant, Anchorage, IRVIN L. TAILLEUR, U. S. Geological Survey, Menlo Park

Jurisdiction over the petroleum exploration program of the former Naval Petroleum Reserve No. 4 was transferred from the Department of the Navy to the Department of the Interior on June 1, 1977. The Naval Petroleum Reserves Production Act of 1976 mandated this transfer and renamed the area the National Petroleum Reserve in Alaska (NPR/A). Under this act, "The Secretary of the Interior shall commence further petroleum exploration of the Reserve as of the date of transfer . . . " beyond that accomplished by the Navy. As a part of the administration of the Reserve, reports are to be submitted to Congress concerning any new or amended plans for exploration.

Additionally, a study of the Reserve is to be undertaken to " . . . determine the best overall procedures to be used in the development, production, transportation and distribution of petroleum resources in the Reserve". Progress reports to Congress are called for with the study to be completed and submitted together with recommendations and any proposed legislation prior to January 1, 1980. Although a deadline exists for this study, no such deadline exists for the exploration of the Reserve.

The Navy conducted two petroleum exploration programs within the Reserve from 1944 to 1953 and from 1975 until June 1, 1977, the time of the transfer to the Department of Interior. Under the second phase of exploration, 7,550 line-miles of multifold geophysical data were obtained and eight test wells were drilled. Seven tests were drilled in the northeast part of the Reserve along the Beaufort Sea coastline between the Colville River and Cape Simpson, primarily in an effort to find a Prudhoe Bay type of accumulation. This part of the Reserve was also the only area for which an Environmental Impact Statement had been prepared. An additional exploratory well was drilled southeast of Barrow. Tests of this well recovered small quantities of gas while the other seven were essentially dry holes.

The exploration program was assigned to the U. S. Geological Survey as of June 1, 1977. Since that date, 3,670 additional line-miles of multifold geophysical surveys were completed and twelve additional test wells were located. As of January 1, 1979, three of these test wells have been plugged and abandoned, four are being drilled, and five are scheduled for drilling in fiscal year 1979 and possibly 1980. These tests are aimed primarily at assessing the overall petroleum potential of the Reserve, but the wells are also located to maximize discovery. Three test wells are to further evaluate the possibility of a Prudhoe Bay type of accumulation; two are deep 20,000-foot tests to pre-Mississippian basement; one is a 15,000-foot test of a thrust sheet sequence involving the Lisburne Group in the foothills; and six test wells of medium depths are to evaluate possible reservoirs ranging in age from Lower Cretaceous to Devonian.

11:40–1:30 LUNCHEON WITH GUEST SPEAKER

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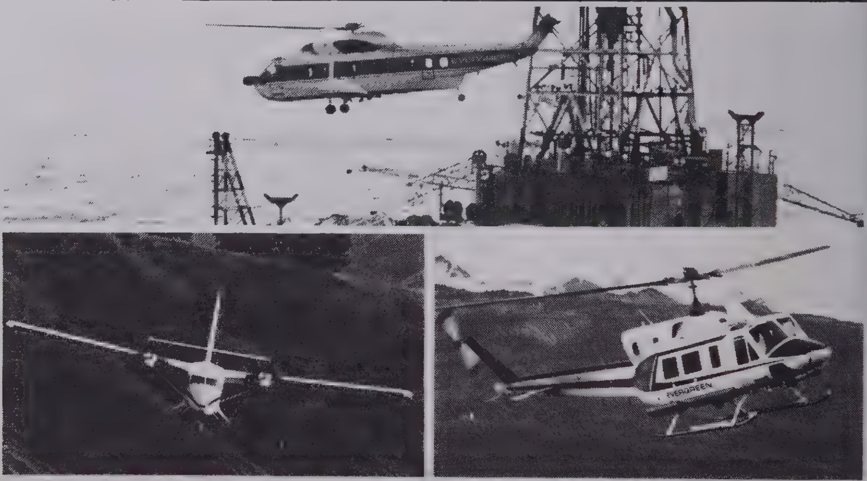

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Monday Afternoon, April 23, 1979

1:30–5:20 p.m.

1:30–2:10 HEAVY MINERAL STUDIES, COOK INLET BASIN, ALASKA

CHARLES E. KIRSCHNER, E. W. CHRISTENSEN, and P. R. WESENDUNK, Chevron USA, Inc., San Francisco

Some representative data from heavy mineral studies in the Cook Inlet basin and adjacent areas of Alaska are presented. The central thesis of the paper is that heavy mineral studies not only provide a supplemental correlation tool but also aid in the interpretation of paleogeographic history and depositional framework of the basin. Four mineral suites are recognized: (a) a hornblende-epidote suite is characteristic of Jurassic and Cretaceous sediments and was derived from Mesozoic volcanic-plutonic arc terranes of the Alaska Range provenance; (b) a garnet suite is characteristic of Tertiary sediments until mid-Miocene and was derived from a high-rank metamorphic rock terrane northeast of the present Alaska Range; (c) an epidote suite is characteristic of the late Miocene and was derived largely from low-rank metamorphic rocks of the Kenai-Chugach Mountains tectonic-arc terranes and (d) a hornblende-hypersthene suite is characteristic of the Pliocene and was derived largely from vocanic-plutonic arc terranes of the Alaska Range.

The data suggest that during the Tertiary and until mid-Miocene, an ancestral Yukon River system deposited a progradational deltaic sequence, derived largely from remote interior terranes directly into the Cook Inlet basin. Deposition of deltaic sediments was overprinted during a mid-Tertiary orogenic episode and was cut off by late Miocene with uplift of the northern Alaska Range. Thereafter, upper Miocene and Pliocene sediments were derived from the provincial Alaska Range and Kenai-Chugach Mountains terranes.

2:10–2:50 BIOSTRATIGRAPHY OF EXXON OCS-Y-0080 No. 1, GULF OF ALASKA

ROBERT D. LATTANZI, Exxon Company, USA, Houston

An upper Miocene to lower Pliocene planktonic foraminiferal fauna occurs in the Exxon OCS-Y-0080 No. 1 well between 8,400 feet and 13,507 feet. The fauna consists of Globorotalia miozea conoidea Walters. Orbulina universa d'Orbigny, Globigerina bulloides d'Orbigny and Neogloboquadrina pachyderma (Ehrenberg). The planktonic assemblage and an associated deep water benthic fauna are found in mudstones and highly glauconitic shales of the Poul Creek Formation. Faunal character and lithological associations suggest that glacial activity did not affect this depositional site until latest Miocene or early Pliocene time.

2:50–3:30 EVIDENCE FOR A SHELF TO BASIN TRANSITION IN MISSISSIPPIAN CALICO BLUFF FORMATION, EAST-CENTRAL ALASKA

MYRON W. PAYNE, Geology/Geophysics Program, University of Alaska, Fairbanks

Studies of composition, texture, and sedimentary structures of the Upper Mississippian Calico Bluff Formation demonstrate that it contains two major lithofacies reflecting deposition in a basinal setting. The dominant lithofacies consists of calcareous or siliceous, platy, autochthonous shales that are interbedded with allochthonous limestones containing abundant fossil debris.

The platy shales occur as blanket deposits ranging from centimeters to tens of meters in thickness. Black calcareous shales contain abundant macrofossils, many of which occur in life assemblages. Siliceous shales are fissile, yellow to reddish weathering, and contain few fossils. The low carbonate and fossil content indicates a more distal marine setting.

The limestone lithofacies contains abundant shallow water shelf fossils that are, generally, chaotically mixed with a black, organic-rich, micritic matrix to produce packstones. Individual beds generally have sharp, sometimes erosional, basal and gradational upper contacts. Fluting, flame structures, load casting, accretionary ripples, and injection features are common. Large scale structures include asymmetric folds and small reverse faults that are bounded at the top and bottom by undisturbed bedding. Measurements of fold axes suggest that these structures are produced by depositional slope failures shortly after deposition.

Deposition occurred on a submarine slope adjacent to a carbonate platform. The shales represent in situ deposition from suspension in the distal area.

Thin graded units of fine-grained biomicrite within shales reflect some turbidity-current activity. Alteration of calcareous and siliceous shale may reflect variation in sea level, proximity to the source area, or a cyclicity in sedimentation.

The limestone beds are allochthonous slope deposits transported by debris flows, fluidized sediment flows, and turbidity currents. Paleocurrent analysis indicates consistent transport from a northeastern carbonate platform during Late Mississippian. The presence of disseminated chert grains and pebbles in the limestone suggests limited uplift on the shelf.

3:30–4:00 COFFEE BREAK

4:00–4:40 MOLLUSCAN BIOSTRATIGRAPHY OF THE UPPER POUL CREEK AND LOWER YAKATAGA FORMATIONS, YAKATAGA DISTRICT, GULF OF ALASKA

CATHERINE A. ARIEY, Geology/Geophysics Program, University of Alaska, Fairbanks (presently with Atlantic Richfield Co., Anchorage)

The Poul Creek and Yakataga Formations comprise a thick sequence of late Eocene through Pleistocene marine deposits in the Yakataga district. Historically, the precise age of the formations, especially the age of beds bounding the contact, has been enigmatic. For this reason, four stratigraphic sections, distributed along 52 km, were measured across the contact within the nearshore area of the Robinson Mountains. A fifth section was measured within the upper Poul Creek Formation.

Mollusks were collected from 149 localities within the five sections: Kulthieth Mountain (142 m), Yakataga Reef (442 m), Lawrence Creek (74 m), and Lare Glacier No. 1 (183 m) and No. 2 (58 m), listed in order from west to east. Systematic study resulted in identification of 61 bivalves, 32 gastropods, and 1 scaphopod. Comparison of the molluscan fauna with mid-Tertiary Oregon and Washington faunas revealed that four of Addicott's (1976) molluscan stages (Juanian, Pillarian, Newportian, and Wishkahan, representing the late Oligocene through early late Miocene in the Pacific Northwest) may be correlated with the upper Poul Creek and lower Yakataga Formations. Addicott (1976) recognized the existence of Pillarian beds within the uppermost Poul Creek Formation. Eastern Pacific faunal affinities (USSR and Japan) generally support these stage correlations.

Although Alaska was a separate biogeographic province from Oregon and Washington in mid-Tertiary time, a few key taxa allow recognition of a complete succession of Pacific Northwest molluscan stages (Juanian through Wishkahan) in the Yakataga district. Unfortunately, an interval, barren of mollusks, 6 to 31 m in thickness, usually straddles the contact zone, but the uppermost Poul Creek Formation generally correlates with the Pillarian Stage, whereas the lowermost Yakataga strata correlate with the Newportian Stage. Only at Yakataga Reef are the beds immediately above the contact definitely Newportian. The Newportian sequence is particularly thin in the eastern Yakataga district (about 20 m in thickness) but is 77 m or more in thickness in the western Yakataga district.

Reference: Addicott, W.O., 1976, Neogene molluscan stages of Oregon and Washington, in Fritsche, A.E., Ter Best., H., Jr., Wornardt, W.W.: The Neogene Symposium, 1976 Ann. Mtg. Pacific Section SEPM, p. 95-115.

4:40–5:20 PALEOZOIC STRATIGRAPHIC FRAMEWORK OF THE KANDIK BASIN AND NORTHEASTERN YUKON FLATS BASIN, EAST-CENTRAL ALASKA

BRUCE I. CLARDY, Geologist, The Louisiana Land & Exploration Company, Denver

The Kandik basin and northeastern Yukon Flats basin of eastcentral Alaska contain one of the thickest sedimentary sequences in Alaska. Virtually every series of geologic time is represented by a variety of lithotypes.

The Cambrian and Ordovician rocks of the Yukon River area include the Funnel Creek Limestone, Adams Argillite, Hilliard Limestone, and Jones Ridge Formation. These units overlie thick Precambrian Tindir Group sediments. The overlying Siluro-Ordovician Road River Formation is represented by an equivalent unnamed carbonate unit in the northeastern Yukon Flats basin. Carbonates and shales of the Devonian Ogilvie Formation and McCann Hill Chert are respectively correlative with the Salmon Trout Limestone and a Middle Devonian carbonate and clastic sequence in the northeastern Yukon Flats. A local volcanic unit, the Woodchopper Volcanics, occurs along the Yukon River and along the Wood River. The Upper Devonian Nation River Formation is not present north of the Salmon Fork River where an age-equivalent Upper Devonian carbonate sequence has been mapped. The Upper Devonian-Lower Mississippian Ford Lake Shale is present only in the southern Kandik Basin area, where it is overlain by the Mississippian-Lower Pennsylvanian(?) Calico Bluff Formation. Isolated Mississippian-Pennsylvanian outcrops have been mapped along the Porcupine and Salmon Trout Rivers. A local intrusive, the Circle

Volcanics, occurs along the Yukon River and south of the town of Circle. A regional unconformity separates the Permian from older rocks. The Permian Step Conglomerate (and age-equivalent Tahkandit Limestone) is a wide-spread unit underlying many of the hogbacks and ridges throughout the Kandik basin area. The Jungle Creek Formation appears to be a regressive clastic sequence that locally interfingers with either the Step or the Tahkandit Limestone.

Facies changes from the Kandik basin to the Yukon Flats basin suggest coeval carbonate shelf, shelf-edge, and basinal paleoenvironments. A broad, northwest-trending carbonate shelf is interpreted to have been present in the Yukon-Kandik area during the Cambrian. Marine transgressions in the northwest and southeast mark the incipient formation of the Keele Range Arch, which becomes well-pronounced with local emergent areas in the Silurian and into the Devonian.

5:30 **ICEBREAKER COCKTAIL PARTY**

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Tuesday Morning, April 24, 1979

8:00–12:00 NOON

7:00–8:00 SPEAKER'S BREAKFAST

II. COAL

8:00–8:35 OVERVIEW OF ALASKAN COAL

ROBERT B. SANDERS, Mining Manager, Alaska Department of Natural Resources, Anchorage

Alaska contains coal resources of approximately 5 trillion tons, but little of this can be classified as reserves. The amount of reserves, in the practical context of Alaska today, is dependent on more than mere presence of coal in economically mineable deposits, but rather must reflect land status, transportation, access, and regulations, all of which are best described as "moving targets". The status of these critical parameters will be described as of April 1, 1979.

8:35–9:10 FEDERAL GOVERNMENT AND ALASKA COAL

CLAUS-M. NASKE and DONALD M. TRIPLEHORN, University of Alaska, Fairbanks

Although coal was probably used by Natives for centuries, the first coal mined for commercial purposes came from the western side of the Kenai Peninsula where the Russians mined as early as 1855. Other coal developments followed, but not until 1900 did Congress extend the coal laws of the United States to Alaska. Attempting to prevent appropriation of vast acreages by corporate interests, the laws on the sale of public lands provided that each claimant take up land in his own interest, and specifically forbade consolidation of claims before entry. Many coal entries were made in the Bering River and Matanuska Valley coal fields, but were soon found to be invalid because the law only permitted location on surveyed land and there was none in the coal fields.

The Coal Act of 1904 changed the survey provision, and most earlier claims were relocated. By 1906 it became known that fraudulent methods were used in filing some claims, and it was rumored that the northern coal fields were eventually to pass to the Morgan-Guggenheim interests which already held monopolies in copper lands, fisheries, and transportation franchises in Alaska.

President Roosevelt withdrew Alaskan coal lands in 1906; in 1907 the withdrawal order was modified to provide that claims already properly filed could proceed to patent. Fraudulent claims were to be cancelled. About 900 claims needed to be investigated, and of these, about 33 claims, known as the Cunningham Claims in the Bering River Coal field, were suspected to be fraudulent. A national scandal grew out of the investigation, the famous Ballinger-Pinchot controversy, which eventually resulted in the dismissal of Pinchot by President Taft and a split in the Republican Party when Theodore Roosevelt formed his own Bull Moose Party. This contributed to the election of Woodrow Wilson in 1912.

Alaska coal lands were finally reopened in 1916, when the Department of the Interior issued regulations to implement the coal leasing law of 1914.

Subsequent production was minimal, although the Navy exhibited interest in Alaskan coal as early as 1904 when it established a coaling station at Dutch Harbor. In 1911-12 the Navy dispatched expeditions to Bering River and Matanuska coal fields to test the coal for Naval purposes. Also under the auspices of the Navy, an Alaskan Coal Commission investigated Chickaloon coal as a possible source of Naval fuel between 1920-1922. During the same period the Coal Creek Mine was reserved for Naval use.

In 1915 the Federal Government began construction of the Alaska Railroad, in part to develop the rich coal resources of the territory. Completed in 1923, it stimulated development of several mines along its right of way. The government also purchased and developed the Eska mine in the Matanuska field to assure the railroad of a dependable coal supply.

In 1930, a special committee of the U. S. Senate was appointed to study the problems of the Alaska Railroad, including the coal supply. During WW II the Federal Government reopened the Eska mine and used soldiers to mine coal.

In 1968 the Federal Government ordered military bases in the Anchorage area to convert from coal to gas. This resulted in the immediate closing of the Matanuska Valley mines.

The 1977 Surface Mining Control and Reclamation Act is the most significant coal mining legislation in many years; its application and impact on Alaska are currently being determined.

9:10–9:45 TRANSPORT AND ARCTIC RESOURCE DEVELOPMENT

BRADFORD H. TUCK, Economist, Federal/State Land Use Planning Commission, and Associate Professor of Economics, University of Alaska, Anchorage

Resource development in Arctic Alaska will be dependent upon the development of a transport infrastructure; however, in-place transportation will not necessarily ensure resource development.

The present paper makes use of a simple transportation network model to consider least-cost transportation systems to support hardrock mineral and coal resource development in western Brooks Range and northwest Arctic Alaska. Because the values of many of the parameters of the model are highly speculative, the modeling program has been designed to facilitate changes in user assumptions.

The principle variables supplied by the model user include construction costs per mile, interest costs of capital, project life, annual operating costs, transport distance, and tonnage shipped. User-supplied values for these variables generate cost per ton mile estimates by transport link and total transport costs to destination.

The present version of the model consists of 18 links, including rail, marine, and highway models, with hypothetical destinations at Seattle and Japan. Transport tonnages have been based on various Bureau of Mines studies and other works dealing with hardrock mineral and coal development in the region.

There are several applications of the model treated in the paper. Using "best guess" values for the input variables, a least-cost system can be identified. In addition, the sensitivity of transport costs to any specific component of transport costs can be analyzed. Finally, the model is used to determine incremental costs of transportation imposed by various land classification patterns.

9:45–10:15 COFFEE BREAK

10:15–10:50 COAL RESOURCES OF THE CRETACEOUS NANUSHUK GROUP, WESTERN ARCTIC, ALASKA

JAMES E. CALLAHAN, U. S. Geological Survey, Anchorage

The nonmarine facies of the Nanushuk Group of Cretaceous age underlies approximately the western half of the coastal plain and northern foothills belt of the North Slope. The hypothetical coal resource is very large, owing to the immense size of the area, the thickness of the nonmarine section, and the almost ubiquitous occurrence of coal beds of minable thickness in outcrops and drill holes throughout the area. However, data on the continuity of specific coal beds or zones are limited to a few small areas of good exposures or where detailed subsurface work has been done. Therefore, most of the identified resources are based on projections from isolated single data points.

The thicker coals are associated with thick channel sandstones and in the western part of the North Slope lie as much as 2,500 feet above the inshore marine rocks of the Nanushuk Group. The intervening transitional zone is predominantly shale, claystone, or siltstone with some thin sandstones and thin discontinuous, locally radioactive coals. The thicker coals apparently were deposited under predominantly nonmarine conditions, probably in interstream swamps on a broad plain marginal to the Colville geosyncline, where deposition was able to keep pace with subsidence over a considerable period of time.

Coal quality varies with stratigraphic position and original depth of burial. The rank ranges from subbituminous to high volatile "A" bituminous, with heating values (moist, mineral-matter free) ranging from about 8,000 Btu/lb. in the coastal plain coals to almost 15,000 Btu/lb. in the foothill coals.

10:50–11:25 CHARACTERIZATION AND EVALUATION OF WASHABILITY OF ALASKAN COALS

P. DHARMA RAO and ERNEST N. WOLFF, Mineral Industry Research Laboratory, University of Alaska, Fairbanks

Alaska has extensive coal deposits that can help lessen the nation's reliance on imported oil and reduce the balance of payments deficit if it is exported to other Pacific belt nations and to the west coast of the United States.

In a program jointly sponsored by the Federal Department of Energy and Usibelli Coal Mines, Inc., 19 channel samples were obtained from the following locations: 7 samples from the Nenana field, 2 samples from the Matanuska field, and 1 sample each from Wainwright on Kuk River, Meade River, Sagwan Bluff, Tramway Bar, Broad Pass field. Jarvis Creek field, Yetna Region near Fairview Mountain, Beluga field, Kenai field, and Little Tonzona coal bed.

Six 100-pound channel samples were collected, and three fractions of raw coal were made: 38mm x 100 mesh, 8mm x 100 mesh, and 14 mesh x 0. These were separated at 1.3, 1.4, and 1.6 specific gravities using perchlorethylene-naptha mixtures. The float-sink products were analyzed for ash, moisture, heating value, total sulfur, and pyritic sulfur. Proximate and ultimate analyses and hardgrove grindability determinations were made on raw coals.

The results show that significant improvements can be made in the heating value of the coal by removing ash by gravity separation. Most Alaskan coals are low in total sulfur and generally have very little or no pyritic sulfur. Reduction in sulfur is significant only with the high sulfur coal from Jarvis Creek. These coals are presently being analyzed to determine reflectance rank, petrographic characteristics, mineral matter, and major, minor, and trace elements. Studies are underway to evaluate the dehydration behavior of Nenana coals, and studies will also be extended to the Beluga coals.

11:25–12:00 RECENT DEVELOPMENTS OF THE BELUGA COAL

BENNO J. G. PATSCH, Placer Amex, Inc., San Francisco

Placer Amex, Inc., has been involved in the Beluga coal field since 1966. Geologic studies, exploration drilling, bulk sampling, and other field work have been carried out to provide the basic information for reserve evaluations, quality determinations, coal preparation, and economic and environmental evaluations.

A large and minable reserve of subbituminous coal has been confirmed that should be able to compete in energy markets at competitive price. The energy markets could be local or involve export to the U. S. West Coast or other Pacific Rim countries. All major possible markets have been made aware of Beluga coal as a viable source of supply; however, no market has as yet made the firm commitment needed to commence with coal development. Meanwhile, Placer Amex is continuing with its marketing effort and is keeping its economic evaluations up-to-date to assist potential customers in assessing the economics and deliverability of Beluga coal for their energy needs.

12:00–1:30 LUNCHEON BREAK

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ALASKA GEOLOGICAL SOCIETY SYMPOSIUM
Alaska's Mineral and Energy Resources, Land Status, and Economics

Monday, April 23

8:00–8:30	Welcoming Remarks *Arlen Ehm, President, Alaska Geological Society* *Peter T. Hanley, Symposium General Chairman*

I. Petroleum Resources

8:30–9:10	Alaska's energy resources *Gene P. Rutledge, Resource Development Council for Alaska, Inc.*
9:10–9:50	State of Alaska oil and gas lease bonus bids: A statistical study *John Lohrenz, U. S. Geological Survey* *E. L. Dougherty, University of Southern California* *P. L. Dobey, Alaska Department of Natural Resources*
9:50–10:20	Coffee Break
10:20–11:00	Oil and gas resource economics of the Gulf of Alaska *William W. Wade and Peter T. Hanley, Dames and Moore*
11:00–11:40	Petroleum exploration of NPR/A *Arlen Ehm, Consultant* *Irvin L. Tailleur, U. S. Geological Survey*
11:40–1:30	Luncheon—Speaker to be Announced
1:30–2:10	Heavy mineral studies, Cook Inlet Basin, Alaska *Charles E. Kirschner, E. W. Christensen, and* *P. R. Wesendunk; Chevron, U. S. A. Inc.*
2:10–2:50	Biostratigraphy of Exxon OCS-Y-0080 No. 1, Gulf of Alaska *Robert D. Lattanzi, Exxon Co., U. S. A.*
2:50–3:30	Evidence for a shelf to basin transition in Mississippian Calico Bluff Formation, East-Central Alaska *Myron W. Payne, University of Alaska*
3:30–4:00	Coffee Break
4:00–4:40	Molluscan biostratigraphy of the Upper Poul Creek and Lower Yakataga Formations, Yakataga District, Gulf of Alaska *Catherine A. Ariey, Atlantic Richfield Co.*
4:40–5:20	Paleozoic stratigraphic framework of the Kandik Basin and Northeastern Yukon Flats Basin, East-Central Alaska *Bruce I. Clardy, Louisiana Land and Exploration Co.*
5:30	Icebreaker Cocktail Party

Tuesday, April 24

7:00–8:00	Speaker's Breakfast

II. Coal

8:00–8:35	Overview of Alaskan coal *Robert B. Sanders, Alaska Department of Natural Resources*

8:35–9:10	Federal government and Alaska coal *Claus-M. Naske and Donald M. Triplehorn, University of Alaska*
9:10–9:45	Transport and Arctic resource development *Bradford Tuck, Federal/State Land Use Planning Commission*
9:45–10:15	Coffee Break
10:15–10:50	Coal resources of the Cretaceous Nanushuk Group, Western Arctic, Alaska *James E. Callahan, U. S. Geological Survey*
10:50–11:25	Characterization and evaluation of washability of Alaskan coals *P. Dharma Rao and E. N. Wolff, Mineral Industry Research Laboratory, University of Alaska*
11:25–12:00	Recent developments of the Beluga Coal *Benno J. G. Patsch, Placer Amex Inc.*
12:00–1:30	Luncheon Break

III. Water, Industrial Minerals, and Mineral Resource Data Banks

1:30–2:10	Potential and developed water-supply sources in Alaska *Larry Dearborn, U. S. Geological Survey*
2:10–2:50	Problems in Alaskan hydrology, practical and/or legal *William E. Long, Alaska Division of Geological and Geophysical Surveys*
2:50–3:30	Aggregate resources of the Prudhoe Bay oil field, Alaska *Randall G. Updike, Alaska Division of Geological and Geophysical Surveys*
3:30–4:00	Coffee Break
4:00–4:40	The Minerals Availability System: A Bureau of Mines Computer oriented mineral-supply-assessment program *R. David Carnes, U. S. Bureau of Mines*
4:40–5:20	Hard mineral inventory in the State of Alaska *Gilbert R. Eakins, Alaska Division of Geological and Geophysical Surveys* *Lloyd Eggan, Alaska Department of Natural Resources*
6:30–	Cocktail Party and Alaskan Seafood Buffet

Wednesday, April 25

IV. Geology of Hard Mineral Resources

8:00–8:40	The Greens Creek project, Admiralty Island, Alaska *John Dunbier, Geoffrey G. Snow, and Thomas A. Butler, Noranda Exploration Inc.*
8:40–9:20	Geologic cross-section and geophysical data across the southwest corner of the Wiseman quadrangle, Brooks Range, Alaska *Garnett H. Pessell, Steve W. Hackett, and Mitchell W. Henning; Alaska Division of Geological and Geophysical Surveys*
9:20–10:00	Carboniferous metallogeny of the northern Brooks Range, Alaska *Paul A. Metz, Mark S. Robinson, Jerry L. Pease, and Larry Lueck; Mineral Industry Research Laboratory, University of Alaska*
10:00–10:30	Coffee Break

10:30–11:10 Significance of geotectonics in the metallogenesis and resource appraisal of southeastern Alaska: A progress report
H. C. Berg, U. S. Geological Survey

11:10–11:50 National Uranium Resource Evaluation (NURE) Program in Alaska
Jule R. Anderson, Bendix Field Engineering

11:50–1:30 Luncheon—Speaker to be Announced

V. Legislation and Economics of Mineral Exploration

1:30–2:10 Geologic information in Alaska: Land decisions
Russel C. Babcock, Jr., Bear Creek Mining Co.

2:10–2:50 Environmental planning and mineral development
Ronald C. Sheardown, Greatland Exploration, Ltd.

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Tuesday Afternoon, April 24, 1979
1:30–5:20 p.m.

III. WATER, INDUSTRIAL MINERALS, AND MINERAL RESOURCE DATA BANKS

1:30–2:10 POTENTIAL AND DEVELOPED WATER-SUPPLY SOURCES IN ALASKA

LARRY DEARBORN, U. S. Geological Survey, Anchorage

Alaska has large quantities of fresh water stored in lakes, glaciers, and snow fields and as ground water in unconsolidated sediments and porous sedimentary rocks. In addition, the aggregate mean annual runoff of streams in Alaska is estimated to exceed one million cubic feet per second. Yet, temporary water shortages from existing supply facilities have occured at some major development centers in southcentral Alaska and on the North Slope. Generally, these shortages have resulted from use conflicts between public supply, industrial and fishery needs, and aesthetic or recreational values.

The geographic and seasonal availability, as well as natural quality, of Alaska's water resources vary greatly, as do the geologic, physiographic and climatic factors that limit the development of desired water yields. Consequently, streams in many areas provide unreliable or inadequate supplies during winter months, and many domestic wells provide low yields that are only adequate for single-family needs.

Although the cost of treatment and distribution may be high, nearby water sources are available to most developments, except for some coastal villages in western Alaska and throughout much of northern Alaska.

Stream water has not been widely utilized as a source because of the high cost of removing the glacial flour commonly present in many streams and of constructing reservoir and diversion structures. Therefore, the exploration for and utilization of ground water is rapidly expanding as population centers grow and as Alaska's mineral resources are mined and processed.

Ground-water development has been very limited throughout much of Alaska; however, the potential yields of aquifers are much greater than their currently developed yields. Major utilization of ground water occurs in the Tanana River valley (Fairbanks area), the Cook Inlet lowlands (Anchorage and Kenai), and in the Resurrection and Mendenhall valleys (Seward and Juneau, respectively). At these places, individual well yields greater than 1,000 gallons per minute have been obtained from alluvial and glacial outwash deposits where permafrost is absent. Comparable yields should be available in geohydrologically similar environments elsewhere in Alaska. No major aquifers have been developed in the glacial and glaciolacustrine sediments of interior valleys and southwest coastal lowlands or in bedrock. However, the potential for high yield from the carbonate rock aquifers of the Brooks Range is indicated by flows from springs as great as 16,000 gallons per minute.

2:10–2:50 PROBLEMS IN ALASKAN HYDROLOGY, PRACTICAL AND/OR LEGAL

WILLIAM E. LONG, Hydrologist, Alaska Division of Geological and Geophysical Surveys, Anchorage

The hydrology section is a relatively new arm of the Alaska Division of Geological and Geophysical Surveys (DGGS). The new section has considered programs in the classic areas of scientific hydrology, such as ground water, surface water, and water quality. However, the reality of water and society has forced considerations into areas beyond simple scientific data collection, interpretation and projection from these data. Nearly everyone has some concern regarding water so that resource considerations cross many paths and are important for the individual as well as large organizations.

Perhaps the major problem in the analysis of Alaska's water resource is collection of data from the many potential sources. The DGGS is the designated division to handle water data. However, many other agencies at local, State, Federal and international levels collect water data. Also individuals searching for a personal water supply develop water data. Coordination of all these data poses a major problem.

Water supply occasionally becomes a problem, even in Alaska where water appears to be everywhere. Most of Alaska's water supply problems are in the permafrost areas of the North Slope, where the petroleum industry, native populations and fish and game managers vie for limited winter supplies. In the cities, conflicts for water occur as population intensity increases. Water rights are becoming more important and creating large demands on the Division of Land and Water Management.

Flood plains are a problem for Alaska as they are elsewhere in the world. Flooding of established communities on flood plains occasionally reaches disaster level, e.g., Fairbanks flood of 1967. New subdivisions and development on flood plains pose new flood plain management problems.

Mining and water quality will continue to provide problems. Many Alaskan streams are naturally contaminated with sediment to levels higher than sediment produced by mining. Chemical contamination from man's activities as well as from natural causes need to be monitored and controlled.

Legal problems relating to ownership and control of waters pose another group of hydrologically related problems. The State has recently been involved in hearings contesting the navigability of streams.

In summary, water problems arise in all areas of hydrology: ground water; surface water; and water quality. Problems in any of these areas of hydrology can grow to become a legal problem. A sound, well-managed, hydrology data base as well as knowledgeable hydrologists will be fundamentally important to the solution of most of Alaska's water resource problems.

2:50–3:30 AGGREGATE RESOURCES OF THE PRUDHOE BAY OIL FIELD, ALASKA

RANDALL G. UPDIKE, Geologist, Alaska Division of Geological and Geophysical Surveys, Anchorage

In the 10 years since the success of the Atlantic Richfield discovery well, more than 150 additional wells have been drilled in the Prudhoe Bay oil field. The exploration, production, and supportive service facilities and the network of interconnecting roads require a gravel aggregate base 1 to 3 meters thick over the tundra. The required maintenance and expansion of this facility network sustain a high annual demand for sand and gravel. Necessary resources are available but utilization is severely limited by engineering and environmental constraints. Excavation sites are evaluated as a function of: (a) size-grade characteristics of the aggregate, including variation with depth; (b) depth to the permafrost table; (c) extent and degree of development of massive ground ice (lenses and ice-wedge polygons); (d) access and haulage distances; (e) overburden thickness and composition; (f) potential problems associated with existing streams, e.g., flooding, drainage impedence, and accelerated erosion rates due to modification of the hydraulic geometry; (g) maintenance of wildlife habitat; and (h) potential use of the excavation site as a water reservoir.

The author completed a series of surficial engineering geologic maps of the Prudhoe field that are being used for quarry site selection and water resource and facility expansion planning. The prime areas indentified for excavation are: (a) inactive flood plain deposits; (b) sands and gravels associated with partially scoured fluvial terraces; and (c) deposits underlying small to intermediate size lacustrine basins, preferably adjacent to river flood plains. Of these, the most desirable source is the inactive flood plain with its lack of overburden, relatively deep permafrost table, excellent particle size distribution, reasonable haulage access, and potential use as a gravity-fed reservoir. However, use of the resource is restricted by the amount that may be taken without affecting fluvial dynamics and aquatic biologic communities. A viable alternative is the low fluvial terraces associated with the Kuparuk and Sagavanirktok Rivers. These areas are visually less obvious due to a continuous tundra vegetation and thin silt overburden. The aggregate composition beneath this thin mantle (1 to 3 meters) is essentially identical to the present flood plain sediments, often contains only minor massive ground ice, and lies above and away from the active flood plains that are of primary environmental concern. Futhermore, such areas are adaptable to reservoir engineering after aggregate removal.

3:30–4:00 COFFEE BREAK

4:00–4:40 THE MINERALS AVAILABILITY SYSTEM: A BUREAU OF MINES COMPUTER ORIENTED MINERAL-SUPPLY-ASSESSMENT PROGRAM

R. DAVID CARNES, Alaska Field Operations Center, U. S. Bureau of Mines, Juneau

The Bureau of Mines is developing and operating a computer-oriented system that allows for the rapid retrieval and analysis of mineral deposit information. The Bureau of Mines Minerals Availability System (MAS) when complete will provide computer-stored deposit information on domestic and foreign mineral deposits. Deposit information contained in the computer data base includes location, name, ownership, history, reserves, geological data, environmental assessments, and actual or proposed mining and milling method descriptions, and capital and operating costs. Mining and milling costs for entry into the computer data bank are derived from actual costs for operating properties, or are estimated for nonoperating or underdeveloped properties. Costs are estimated by using a cost-estimating system developed specifically for the MAS. Properties are evaluated further through a computer analysis program that projects simulated mine operation cash flows. Developed deposit reserve figures and accompanying commodity costs have been completed for domestic aluminum, chromium, and copper.

4:40–5:20 HARD MINERAL INVENTORY IN THE STATE OF ALASKA

GILBERT R. EAKINS, Chief Mining Geologist, Alaska Division of Geological & Geophysical Surveys, Fairbanks and LLOYD EGGAN, Systems Programmer, Alaska Department of Natural Resources, Anchorage.

The Statehood Act of 1959 granted Alaska the right to select 104 million acres of Federal land. In 1976, after implementation of the Alaska Native Claims Settlement Act and the d-2 bill, the Department of Natural Resources began making an inventory of 34 categories of natural resources on all lands in the state. This is part of the process for making State land selections and for dealing with the existing complex land situation. Approximately 186 million acres of Alaska are estimated to have significant mineral potential. This paper describes the portion of the program used in the spring of 1978 for the inventory of the hard mineral resources.

Seven criteria were used in scoring 18,000 townships. These criteria and their algorithm, or weighing factor, are:

Criterion	Algorithm
1. Industry nominations	1.0
2. Exploration activity	0.4
3. Claim density	0.8
4. Regional geology	1.4
5. Mineral indicators	1.2
6. Known reserves	1.4
7. Past production	1.0

The scoring provided relative rankings of areas for their mineral potential, not for a reserve estimate or a commodity inventory. Scores for each criterion were posted on separate 1:1,000,000 scale maps of the state with a township base. Details of the scoring process and sources of the basic data are described.

The seven resulting maps were submitted to the Planning and Research section of the Department of Natural Resources for computer processing.

Two print-outs were produced immediately. One listed each township by region together with its score for each criterion, computed raw score, normalized score, and ranked the number of land parcels having identical scores, land status, or ownership. The second print-out listed each township in the order of its total score. These data, along with those for the other resources, have been used at the d-2 hearings in Washington, D.C., in making State land selection, and for special site-location studies.

Provisions are built into the system for updating any of the data and for revising the scoring. A preliminary map showing the top four 10 percentiles was compiled by the Research and Planning Section, and more complete maps are planned.

The deficiencies and problems related to an inventory of this type that covers such an immense area are readily recognized. The Research and Planning Section is in the process of expanding the computer hardware and programs for handling resource data to serve many public and private needs.

6:30 COCKTAIL PARTY AND ALASKAN SEAFOOD BUFFET

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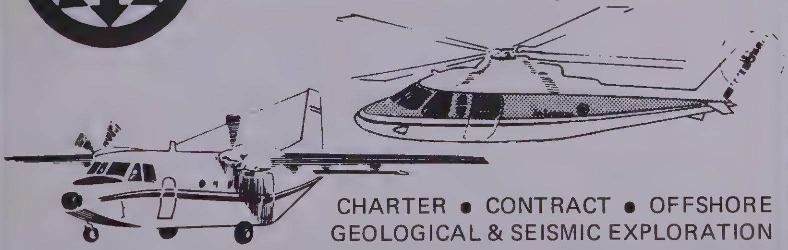

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Wednesday Morning, April 25, 1979
8:00–11:50 a.m.

IV. GEOLOGY OF HARD MINERAL RESOURCES

8:00–8:40 THE GREENS CREEK PROJECT, ADMIRALTY ISLAND, ALASKA

JOHN DUNBIER, GEOFFREY G. SNOW, and THOMAS A. BUTLER,
Noranda Exploration Inc., Anchorage

Greens Creek is located on northern Admiralty Island, approximately 18 air miles southwest of Juneau. Mineralization was discovered there in 1974 during the follow-up phase of a regional geochemical reconnaissance program in southeast Alaska by the Pan Sound Joint Venture.

Admiralty Island is situated within an active mobile belt bordering western North America and has been the site of marine eugeosynclinal deposition and intermittent deformation throughout most of the Paleozoic and Mesozoic. The U.S. Geological Survey has mapped Devonian, Permian and Triassic rocks on northern Admiralty Island, but we are unable to distinguish the Devonian from the Permian rocks in our area of mapping. We refer to the succession of metamorphosed equivalents of shale siltstone, graywacke, chert, limestone, and abundant volcanic, volcanoclastic rocks, and chemical exhalative products as the "Greens Creek group".

Seven prospects, representing different depositional environments, have been identified to date. The most promising of these is the Big Sore, named for an oozing ferricrete deposit located where the mineralized bed crops out. Precious and base metal sulfides and sulfosalts are localized on lower limb of an overhead anticline. The ore zone lies between a structural hanging wall of felsic tuffaceous volcanoclastic, sedimentary and chemical exhalative rocks and a footwall of black carbonaceous argillite. The mineral deposits formed in brine pools in a restricted intra-arc or backarc basin from hydrothermal solutions rising along faults. The mineralized zone was covered by the carbonaceous argillite and was likely deformed prior to lithification.

Sulfide-rich pods vary in thickness from 0.5-foot thick, high-grade silver and gold-rich zones to 90-foot thick base metal zones. Drilling has delineated five ore pods which contain 2.1 million tons of "drill indicated" reserves whose average grade is 0.41% Cu, 3.29% Pb, 10.04% Zn, 9.46 oz/t Ag, and 0.13 oz/t Au. The ore zone is open down-dip below the 1,300-foot elevation and along strike to the south.

Helicopter-supported exploration has resulted in minimal surface disturbance. Presently, a 9 x 12-foot exploration adit is being driven 4,300 feet into the hanging wall. From this adit, 33,000 feet of diamond drilling will be accomplished to develop data for a feasibility study. Pending that study, and barring unfavorable political and environmental delays, the Big Sore deposit could be ready for production in 1983.

8:40–9:20 GEOLOGIC CROSS-SECTION AND GEOPHYSICAL DATA ACROSS THE SOUTHWEST CORNER OF THE WISEMAN QUADRANGLE, BROOKS RANGE, ALASKA.

GARNETT H. PESSELL, STEVE W. HACKETT, and MITCHELL W. HENNING, Alaska Division of Geological & Geophysical Surveys

NO ABSTRACT AVAILABLE

9:20–10:00 CARBONIFEROUS METALLOGENY OF THE NORTHERN BROOKS RANGE, ALASKA

PAUL A. METZ, MARK S. ROBINSON, JERRY L. PEASE and LARRY LUECK, Mineral Industry Research Laboratory, University of Alaska, Fairbanks

Significant zinc-lead-copper-silver-barite-fluorite mineralization occurs in Carboniferous sedimentary volcanic rocks of the northern Brooks Range. The mineralization has been traced intermittently for 800 km in an east-west trending belt from Porcupine Lake in the Arctic quadrangle to the Wulik River in the DeLong Mountains quadrangle. In an attempt to better understand the nature of the mineralization and the enclosing rocks, detailed geologic mapping was conducted at Porcupine Lake, and in the Atigun Canyon area. Detailed geochemical sampling of approximately 2,500 sq km was undertaken in the area between Galbraith Lake and Shainin Lake to evaluate the resource potential of the rocks in this part of the Brooks Range. Close spaced geochemical sampling was done over the exposed mineralization at the Drenchwater Creek and Red Dog Creek mineral occurrences in an effort to establish baseline geochemical information for this type of mineralization.

The mineralization at Porcupine Lake, at the eastern end of the belt, consists of argentiferous tetrahedrite, enargite, malachite, azurite, fluorite, and minor barite, bornite, chalcocite, covellite, and pyrite. The ore minerals occur as open space fillings and replacements in carbonate rocks of the Lisburne Group. In the Atigun Canyon area, in the Philip Smith Mountains quadrangle, numerous occurrences of barite mineralization and several large copper and zinc geochemical anomalies have been found; however, no base metal mineralization has been observed. The barite mineralization is limited to the Permo-Triassic rocks, but geochemical sampling indicates that the entire Devonian through Triassic clastic and carbonate sequence has good mineral potential and may contain base metal sulfide mineralization.

In the Drenchwater Creek area, in the Howard Pass quadrangle, major sphalerite and galena mineralization occurs associated with upper Mississippian dacitic flows and volcanoclastics. The ore minerals occur primarily as disseminated grains in the volcanics and in the sedimentary rocks and appear to have been deposited contemporaneously with the enclosing rocks. Sulfides also occur in narrow veinlets and as breccia fillings in the volcanoclastics, suggesting local remobilization.

In the Wulik River area of the DeLong Mountains quadrangle, major sphalerite-galena-barite mineralization has been found at several localities. The mineral occurrence at Red Dog Creek is the best exposure of massive sulfide mineralization found in the area and consists of disseminated grains, breccia fillings, and as replacement veins in the black chert facies of the Lisburne Group. Unlike the occurrence at Drenchwater Creek, no well defined volcanic rocks have been identified at the Red Dog occurrence.

From the above investigations the following generalizations can be drawn:

1. The copper-silver-fluorite-barite mineralization of the eastern Brooks Range is associated with carbonate-rich tuffaceous and silicified limestones of the Alapah Formation of the Lisburne Group.
2. The zinc-lead-barite mineralization in the DeLong Mountains is associated with volcanic and volcanoclastic rocks of the black chert facies of the Lisburne Group.
3. The host rocks show strong local basinal affinities and the mineralization generally appears to be controlled by physiographic lows that may be aborted rift systems.
4. The extent of the mineralization is probably much larger than is obvious by surface exposure since major geochemical anomalies are found in areas of low relief and tundra cover.
5. The elemental associations appear to differ over the length of the mineral belt with copper-fluorite-barite of greater abundance in the east end and zinc-lead-barite more prevalent near the western end of the belt.

10:00–10:30 COFFEE BREAK

10:30–11:10 SIGNIFICANCE OF GEOTECTONICS IN THE METALLOGENESIS AND RESOURCE APPRAISAL OF SOUTHEASTERN ALASKA: A PROGESS REPORT

H. C. BERG, U. S. Geological Survey, Menlo Park

Southeastern Alaska consists of parts or all of nine fault-bounded geotectonic (tectonostratigraphic) terranes. Each terrane is characterized by distinctive stratigraphic sequences that differ substantially from those of adjoining terranes. Their grossly dissimilar geologic and structural histories imply juxtaposition by large-scale tectonic transport. This juxtaposition produced a mosaic of discrete tectonic elements that record a long and complex history of amalgamation and accretion to the continental margin of North America. The history of amalgamation begins in Permian, the age of the oldest rocks known to overlap any two of the terranes. The major episode of accretion apparently was in Late Cretaceous, the age of the youngest regionally penetratively deformed rocks in southeastern Alaska. Subsequent tectonic activity has been mainly (a) redistribution of the terranes along major fault zones, such as the Chatham Strait fault, and (b) Cenozoic intrusion, thermal metamorphism, and local deposition of continental volcanic and sedimentary rocks.

The differences among the terranes imply fundamental difference in their origin and tectonic history, and consequently in the origin, distribution, types, controls, and history of mineral deposits that occur in them. A key factor in testing and applying such a geotectonic model in metallogenic analysis and resource appraisal is that it predicts basic differences in mineral deposits that originated in different terranes before they were assembled. It also predicts (a) potentially important modifications to preexisting mineral deposits during and after amalgamation and accretion of the terranes and (b) important regional similarities among certain types of mineral deposits that originated during and after final accretion of the terranes.

The classifications and interpretations presented in tabular form are preliminary or speculative and are based on my own reconnaissance investigation, on my interpretations of reports published by U. S. Geological Survey colleagues, and on information released by mining companies. Such classifications and interpretations may change substantially after detailed future studies of the region's mineral deposits, geology, and tectonics.

11:10–11:50 NATIONAL URANIUM RESOURCE EVALUATION (NURE) PROGRAM IN ALASKA

JULE R. ANDERSON, Bendix Field Engineering Corp., Anchorage

NURE is a program directed by the Grand Junction, Colorado office, United States Department of Energy (DOE), to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to identify areas favorable for the occurrence of uranium deposits in the United States. The prime operating contractor for the Grand Junction Office of DOE is the Bendix Field Engineering Corporation (BFEC). The effort now planned will result in a comprehensive uranium resource report in 1980 covering certain priority areas of the United States; evaluation of the balance of the nation is to be completed by 1985.

To accomplish objectives, NURE has been divided into several program elements. A principal element of the NURE program is the geologic evaluation of NTMS 1:250,000-scale quadrangles; this element is conducted by the BFEC Geology Division, its subcontractors, and the United States Geological Survey. To a large extent, all program elements are directed toward the support of the quadrangle evaluation studies and the resultant assessment of the potential uranium resources of the nation.

In Alaska because of the lack of an adequate information base from which to start and due to unique logistical problems, regional aerial radiometric and magnetic surveys, regional geochemical sampling and other preliminary studies are considered basic to evaluations; this work is about fifty percent completed in Alaska.

Quadrangle evaluation is the responsibility of the BFEC Geology Division which maintains field offices at nine locations, including the Alaska office in Anchorage, from which in-house quadrangle evaluation projects are conducted and subcontracted work is monitored.

Twenty-six quadrangles in Alaska were chosen on the basis of available information for evaluation by 1983; 11 are planned for completion by mid-1980. Remaining areas in Alaska are to be completed by 1985. Most work in Alaska has been or will be subcontracted to organizations experienced in Alaskan geology. Evaluations have been completed on six quadrangles and work is in progress on five additional quadrangles.

Two aspects of the NURE program are of special importance to Alaska. These are: 1) under NURE all geological environments are to be investigated including those at present not indicated to be favorable; and 2) utilization of information generated by other NURE program elements, as well as from all available sources of information, is basic to evaluation. But the emphasis of all quadrangle evaluation is on field work.

11:50–1:30 LUNCHEON WITH GUEST SPEAKER

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Wednesday Afternoon, April 25, 1979
1:30—2:50 p.m.

V. LEGISLATION AND ECONOMICS OF MINERAL EXPLORATION

1:30–2:10 GEOLOGIC INFORMATION IN ALASKA: LAND DECISIONS

RUSSELL C. BABCOCK, JR., Vice President, Bear Creek Mining Co., Spokane

Beginning in 1976 and extending through 1978, the Congress of the United States deliberated seriously on the proper classifications of 80 to 150 million acres of Alaskan land, including the d-2, National Interest Lands to be considered for inclusion in the National Park, National Wildlife Refuge, Wild and Scenic Rivers, and National Forest systems. In parallel with this effort, a great deal of private, State and Federal exploration and geological evaluation was taking place. The intention of private industry was to explore for mineral deposits of above average economic character in hope that discoveries would lead to new mineral developments. Obviously, this effort was excluded from most of the d-2 lands originally withdrawn for Park or Refuge consideration but included Native Corporation lands.

Government studies concentrated on those economically most interesting lands that were most likely to be withdrawn or for which the least information was available. Specific USBM programs were designed to evaluate existing mineral claims and occurrences on d-2 lands, and State and USGS programs were aimed at providing regional geological-geochemical data. Much of this government work was, in fact, mineral exploration.

Data resulting from these private and government efforts were compiled by each group and submitted in a variety of forms to Congress for consideration. Federal government data were presented as specific regional reports and as maps indicating metallogenic provinces with only major occurrences identified. State data consisted of a computer ranking of potential on a township basis. Industry data were presented as site-specific-mineral-occurrence data with important trends or metallogenic provinces also shown. Each group discussed their own data at hearings, and industry presented specific regional or deposit data through visits to Congressmen and in writing.

All available data were theoretically considered by the House Subcommittee on Oversight and Alaska Lands, and by the Senate Committee on Energy and National Resources. Comments from members and staff of these committees will be presented to illustrate both the use and effectiveness of the data.

As a result of the experience of the author in presenting the data to Congress, and the comments of those using it, specific recommendations will be made concerning the methods of using minerals data to gain a positive impact in future land-use decisions in Alaska and elsewhere. The pros and cons of an "open" policy, one which maximizes data accessibility to the public, will be covered.

2:10–2:50 ENVIRONMENTAL PLANNING AND MINERAL DEVELOPMENT

RONALD C. SHEARDOWN, Greatland Exploration, Ltd., Anchorage

Major mineral developments in the undeveloped regions of Alaska inevitably require the preparation of a detailed environmental report prior to the issuance of Federal and State permits to operate the facility. The reports are utilized by Federal agencies for the preparation of an Environmental Impact Statement (EIS).

The nature and size of the project, land status, and types of discharges from proposed facilities determine what permits will be required. In general, if there is a process water discharge or a large air emission from fuel burning equipment in the mill, permits and ultimately an EIS will be required.

Until recently, each Federal agency had its own requirements for the preparation of impact statements. After extensive review by industry, government, and the environmental community, the Council of Environmental Quality (CEQ) reversed the procedures and requirements for the preparation of impact statements and directed all Federal agencies to follow the same guidelines and procedures. This change has substantially improved the process and should insure more expeditious processing of impact statements.

Anyone seriously considering the development of a mineral property in Alaska should evaluate the environmental implications of the project at the same time the preliminary feasibility studies begin. Incorporating environmental planning at an early stage in project development insures that problems are uncovered when they are relatively easy to solve and facilitates the entire EIS permit process.

In the early 1970's the developers of the Lost River Project began environmental work early in their planning process and received approval for their impact statement 3 years from the date work began on the EIS. Through a well-coordinated effort, the process could be completed within the same time today.

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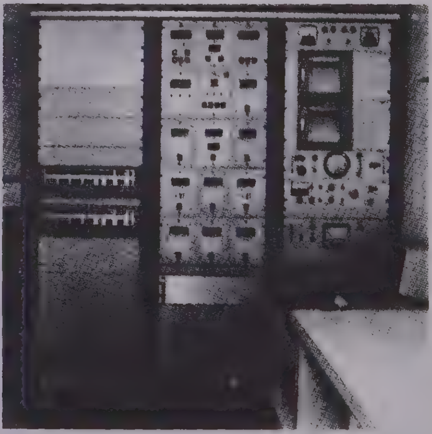

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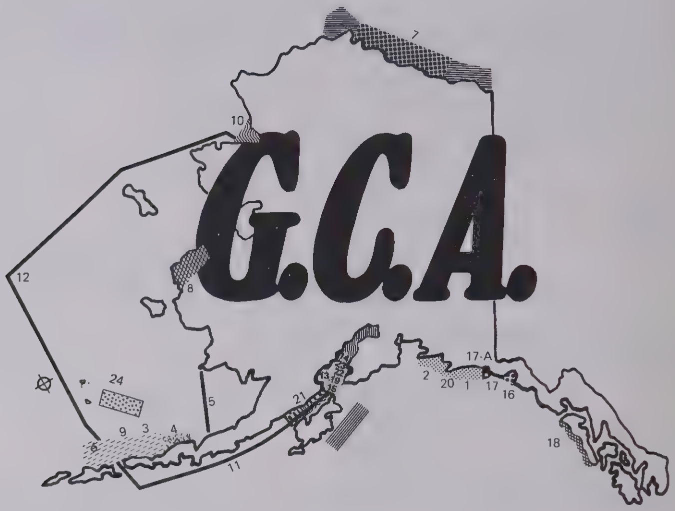

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